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United States
Department of
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Animal and
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FOREWORD

The Mediterranean fruit fly, Ceratitis capitata (Wiedemann) (Medfly), considered to be the world's most destructive fruit pest was discovered at two locations in California in June 1980. Early program actions were initiated and results were successful in some instances, but unsuccessful in others. There were delays in using all of the available and proven technological tools, resulting in a prolonged eradication effort that extended over 27 months. During the period of time regulations were in place and eradication activities were underway, daily routines of millions of people were altered. Not only were the governmental units conducting the program impacted, but other State and foreign governments, concerned organizations, industry, and the general public were affected.

With such a broad segment of the national and international communities affected by the Medfly infestation, it seemed proper to summarize the activity for presentation to professionals who might benefit in future endeavors.

The Emergency Programs staff is grateful to the authors of the following presentations who took time from their schedules to prepare and participate in the Symposium.

B. Glen Lee
Emergency Programs Coordinator

A REVIEW OF THE CALIFORNIA ACTION PROGRAM

Jerry Scribner
Deputy Director,
California
Department of
Food and
Agriculture,
Sacramento, CA

Good afternoon, Dick Jackson and I have been given 15 minutes each to describe the California/U.S. Department of Agriculture (USDA) Medfly Action Program--California, or how we spent our summer vacation.

Dick and I wanted to tell you how we followed textbook entomological advice in carrying out a swift, inexpensive, and totally effective eradication strategy. However, Dr. Mussman said we had to tell the truth.

Unfortunately, as you all know, the entomology textbook on eradication is a little fuzzy because each insect in a new environment is, by its nature, an unstudied phenomenon. The tools we used in 1981 in the Santa Clara Valley were modified from tools used in previous Medfly eradication efforts and are likely to be modified or changed completely before the next Medfly infestation depending on the circumstances and scientific advances between now and then.

The California/USDA action program against the Medfly in Santa Clara Valley between 1980 and 1982 was fairly straight forward--we tried eveything! In fact, we used every technique that had ever been used successfully against the Medfly except ground applied lead arsenate, which was used in Florida in 1929. We first tried the approach California and USDA had used successfully in 1975-76 to eradicate Medfly from Los Angeles--the release of millions of sterilized Medflies. It worked again in Los Angeles in 1980. When it did not work in Santa Clara, we moved to a massive ground program of fruit stripping and ground spraying similar to that used in Florida in 1929-32, plus increased sterile releases. We thought this was working because no wild males and no larvae were identified from the end of January to June 24, 1981. When more than 100 larval sites appeared suddenly in late June and early July 1981, we turned to aerial spraying. The aerial program was buttressed by three ground applications in thousands of backyards using diazinon, a material not previously used for Medfly eradication.

We also stopped 5.2 million cars and trucks at roadblocks; handled over a quarter of a million telephone calls at phone banks; placed and monitored weekly more than 100,000 Medfly traps throughout the State; and mobilized thousands of local residents in public education and "Worm Watcher" activities.

What Dick and I would like to do, in the half hour allotted to us, is take you through this massive 2 year, $100 million effort with the help of some slides.

Based on what we have learned, we know how to fight Medfly in the Santa Clara Valley of California under 1980-82 conditions. How much of that knowledge can be and should be applied to the next Medfly infestation, wherever it is and under whatever conditions, will have to be determined by eradication project managers at that time.

To set the stage, I want to focus for a minute or two on the complexity of making and carrying out eradication decisions in a democracy. If the Medfly or some lesser known pest arrived in your backyard and quickly spread through just your immediate neighborhood, could you get all your neighbors together for a meeting, review the literature and possible eradication strategies, and reach agreement on what needed to be done?

One problem, of course, is getting people to come to a meeting. Many husbands and wives work, many are single parents, people are busy with other activities, and some are on vacation. Once you get there, there are some people who are all for pesticides and some who are all against them. There are some who want a quick solution and others who do not care how long it takes as long as the disruption is minimal.

Our problems were similar but much bigger. Instead of one small neighborhood, we had eight counties, each with a 5-member board of supervisors elected by the public; 44 cities, each with a city council from 7 to 15 members; plus approximately one-fourth of the California Legislature, who lived in the spray zones. More than 2 million families were involved.

Our ability to clearly and accurately communicate the proposed strategy and the risks and the benefits were limited by the fact that the media is a competitive business enterprise with the most titillating and scary coverage competing for advertising revenue.

In addition, there were other scientists who saw the risk benefits differently and said so. We had more Ph. D.'s per acre in the spray zones than probably anywhere in the country. We had experts and scientists at University of California, Berkeley, Stanford University, San Jose State College, and more than a dozen junior colleges. We had physicians who told the public that spraying was safe, but we also had 44 doctors sign an open letter to the public saying 1 out of every 1,800 people would die or be seriously injured if the spraying took place. You can see why decisionmaking in a democracy is difficult, especially when time is short.

Carrying out the decision, once made, is also quite a challenge under our system of government. One reason is that so many different agencies have overlapping responsibilities.

I have often noted that Christopher Columbus did not know where he was going, did not know where he was when he got there, and did not know where he had been when he got back. We think we know where we have been, but Dick and I think Columbus had it easy--at least he was alone. If Columbus had been treated like a modern-day eradication manager, his ships would have been purchased from the lowest bidder by the Department of General Services, and his crew hired for him by the State Personnel Board and Civil Service Commission. The rigging would have been arranged by California Occupational Safety and Health Administration (Cal/OSHA) not for sailing, but for crew safety, and every time a sailor slipped on the deck or grumbled about the food, Columbus would have had a full complement of television and radio microphones there to record the man's opinion of Columbus and of the whole operation. On the poop deck, Columbus would have had a Technical Advisory Committee (TAC)--like we did--of experts armed with the latest knowledge of the day.

Politically, Columbus had it easy, he had only to please Isabella and maybe Ferdinand. We had to please a Democratically controlled State Assembly, a Republican-controlled State Senate, a Democratic Governor, and a Republican President.

There were not as many public interest organizations in those days either. History might be different if the American Indian movement had greeted Columbus' party on the shores of Cuba, instead of friendly natives. Our spray zone was the home of the Sierra Club, Friends of the Earth, Citizens for a Better Environment, and other urban environmental interest groups. We also received advice from the California Farm Bureau Federation and various farm groups wearing buttons that said, "Let Us Spray."

What I would like to do now is turn to the slides, and take you very quickly from June 1980 to August 1981. Dick Jackson will then cover the second half of the Medfly eradication project and talk about some of the key lessons learned and directions from here.

Slide Presentation

A. History

The northern California Medfly Project can be divided into three distinct phases. The first phase was from June to December 1980. The primary eradication technique used was the release of 1 billion sterile flies. The second phase ran from December 1980 to June 1981, when a massive and unprecedented fruit stripping and ground spraying strategy was attempted, along with the release of 3 billion more sterile flies. The third phase ran from July 1981 through the summer of 1982 and involved aerial spraying of malathion bait similar to that used in Texas in 1966, plus the ground spraying of diazinon around larval finds.

B. Sterile Fly Releases

In the summer of 1980, the first flies were released around the middle of July. By the end of August, a total of about 300 million sterile flies had been released. Another 700 million were released between September and December. However, these numbers were far too few for the number of wild flies present in the area. Approximately 60 percent of the flies were released on the ground by roving release trucks. Forty percent of the sterile flies were released by air. Scientists on the Technical Advisory Committee disagreed on whether aerial release or ground release was the most effective.

By August 1980, when it was clear that there were not enough quality sterile flies available to eradicate the infestation, the Technical Advisory Committee recommended limited ground spraying to the most heavily infested neighborhoods. Program managers attempted to spray 4,500 backyards one time with malathion bait. However, State law required homeowner permission and many homeowners were unavailable to give permission or, if available, refused to give permission. As a result, only about half of the yards were sprayed at all, further limiting the program's effectiveness.

By November 1980, the infestation had expanded northwestward into Palo Alto and across the San Francisco Bay into Alameda County. A request for additional sterile fly shipments from the U.S. Department of Agriculture/Mexico laboratory in Metapa was denied on the grounds that the flies were needed for the Mexican eradication program. In December, aerial spraying was proposed, but community opposition prevented its implementation. Program managers appeared before six local

government city councils and county boards of supervisors seeking spraying approval and were turned down on each appearance.

On December 24, 1980, the Governor declared a state of emergency and mobilized resources from six State agencies to carry out a massive ground-based program during the winter months. I, as a Deputy Director in the Department of Food and Agriculture, was assigned to take over the project and was given sweeping powers to assemble the necessary personnel and equipment.

C. Ground Program

The ground program had four key elements: (1) Stripping all Medfly hosts on or near previous larval finds; (2) tightening the quarantine; (3) applying malathion bait on the ground; and, (4) releasing more sterile flies.

An abandoned local school became the headquarters for a force that grew from 200 to 2,000 over the next several weeks. On the first Sunday in January, the Medfly Project placed full-page advertisements in local newspapers asking community residents to strip the fruit from their trees and to telephone in any maggot finds. One week earlier, volunteer coordinators had been appointed in each city and phone banks and other community volunteer program planning undertaken.

The eradication program concentrated in a 50-square-mile (12,950-ha) area formed by delimiting a 1-square-mile (259-ha) eradication zone around each previous larval find. State employees went door to door in this 50-square-mile area leaving notices of the proposed stripping and ground spraying program at each residence. There were 3,000 blocks and over 100,000 homes in the affected area. The door-to-door notices included phone numbers residents could call. There were separate numbers for fruit stripping and for ground spraying calls. Employees in the ground spray phone bank took calls and made sure that the right information got into each folder for each neighborhood block.

D. Fruit Stripping by State Crews

Four hundred members of the California Conservation Corps (CCC), led by Food and Agriculture inspectors, began going door to door stripping fruit on January 6, 1981. They first knocked on the door to make sure residents were cooperating in the program or not home. If not home, they looked over the fence to make sure there was not a big dog in the

backyard and then went in and checked for host fruit. About 45,000 properties had host fruit and were stripped. Most of the fruit stripped was citrus, avocados, or persimmons, but some other fruit, such as that of the prickly pear cactus, was also stripped.

The fruit was stripped and put into 30-pound (13.5-kg) plastic bags, which were then stacked by the roadside, from where it was collected in dump trucks manned by California Department of Transportation (Caltrans) crews. The Caltrans trucks took the fruit to one of seven dump sites where it was buried under 2 feet (60 cm) of soil, in the presence of agricultural inspectors. During the 5-week stripping program, approximately 45 tons (41,000 kg) of fruit was collected.

The CCC worked 6 days a week, rain or shine. They even donated more than 100 pints of blood on one of their few days off. They were assisted by the California National Guard as well as by Caltrans. The CCC force grew to more than 1,000 workers during January, about half of whom were women. All were housed at the Santa Clara County Fairgrounds. The CCC was fed by Department of Forestry Fire crews. They got up at 0430 to take showers in shifts and also had to eat in shifts to accommodate the large number of people. Since the Santa Clara County Fairgrounds had shower facilities for only a few people, the National Guard erected shower tents and dug a sump into the county fairgrounds to collect runoff. The Medfly Project repaired the county fairgrounds at the end of this period.

E. Fruit Stripping by Homeowners

In addition to the stripping by the CCC, homeowners, organized by volunteers in each of the 16 cities in the surrounding areas, stripped fruit in the remaining 450-square-mile (116,500-ha) quarantine area. The Medfly Project supplied plastic bags, ladders on loan, and trucks to pick up the stripped fruit.

Many homeowners hauled their stripped fruit to the dump themselves. In the early weeks of the program, there were long lines at the seven county dump sites, as well as a complete sellout of food processors and juicers from neighborhood stores, since processed fruit did not have to be dumped. Community cooperation in the stripping program varied from city to city, but was very high in all areas.

City volunteer coordinators estimated that 60 to 95 percent of the fruit in the entire quarantine area was stripped during this period.

In addition to the stripping and ground spraying program, the Medfly Project increased the quarantine surveillance. Signs were erected on the freeways and inspections increased at airports, fruit stands, flea markets, and other points where produce was sold or handled.

F. Ground Spraying

The Cupertino Caltrans Yard was the center of the ground spraying program which involved about 550 employees and 118 ground spray rigs. Ground spraying went on 6 days a week.

Ground spray employees had blood tests 72 hours apart to establish a baseline cholinesterase level and they had to have additional blood tests if they showed any sign of illness. Ground spray crews met a 0730 for briefing and then safety checking of all equipment. In addition, the Medfly Project was inspected more than 1,100 times by Cal/OSHA and the Pesticide Safety Unit of the Department of Food and Agriculture. During the night, each night, another crew worked all night to fill the gas tanks and get all of the equipment lined up and ready for the next day's spraying, so that when the daytime crews arrived, they could check out the equipment and move out on time.

As with fruit stripping, block folders were kept for each of the 3,000 blocks and over 50,000 residences involved in the ground spraying program. Each night, a crew at Medfly headquarters logged in all the spraying done for that day and prepared assignment sheets for the 118 spray crews for the following day. Folders had to include any information received from the phone bank on residents who had called in with medical problems, had locked gates, or had other objections to spraying. From January to June 1981, 62,000 backyards were sprayed 6 times with malathion bait.

Backyards around larval finds also were sprayed with diazinon as a soil drench to kill larvae and emerging pupae. Diazinon was used beginning in late June 1981. Earlier the program had used fenthion in backyards, but this was abandoned in early February when fenthion proved to be ineffective against Medfly in Santa Clara County.

Since loquats are a prime host in Hawaii, we sprayed, stripped, and released sterile flies around loquats.

Unfortunately, loquats did not turn out to be a significant host in Santa Clara. During the spring, we caught no Medflies or Medfly larvae in loquats.

G. Sterile Fly Release

The fourth element in the intensive winter/spring eradication program was the greatly increased release of sterile flies. From June to December 1980, about 1 billion sterile flies were released. In the next 6 months, this number was tripled to over 3 billion.

The Medfly Project initally received flies from the USDA/Mexico laboratory in Metapa, the USDA/Costa Rican laboratory, as well as the USDA/Hawaiian laboratory. These sources of supply were never adequate for California's needs. Consequently, on January 29, 1981, a team was sent by the Medfly Project to Hawaii to build a new Medfly rearing facility in cooperation with the Hawaii Department of Agriculture, in 6 weeks. The job took 8 weeks, but by early April sterile Medflies began arriving at the project in California from the new source.

Medflies from Metapa were dyed red and arrived at up to 100 million per week. Medflies from the California facility in Hawaii were dyed blue and averaged 65 to 85 million a week. Flies from Peru, which began arriving in December, were dyed yellow, and flies from the USDA/Hawaii laboratory were dyed green.

The sterile fly pupae arrived in jugs or polyethylene bags in lots of 6 to 60 million. Medfly Project personnel met the shipments at the airports and rushed them back to Medfly headquarters where they were put into Kentucky Fried Chicken buckets or boxes, depending upon whether they were destined for ground or aerial release. Each bucket held 3,500 to 5,000 sterile flies.

After 3 days incubation at 80° F. (26.5° C.), most of the flies had emerged from the pupae and were ready for release. They were loaded into Medfly release trucks and driven into the neighborhoods. We used 13 trucks, making 3 trips a day, 5 days a week during the spring. The trucks had a heater to keep the flies warm in the winter and shade to keep the flies cool in the summer so that they could be released in the best possible condition. The trucks had a 3-person crew--a driver, a navigator to track the location and lots being released, and a person in the back who did the actual release.

During the intensive winter/spring program, a total of 43 wild Medflies were captured, all of which were female and many of which were immature. One fly was captured in March, 31 more between April 6 and May 6, 2 more after that in May, and 9 were captured from June 1 to 5. After June 5, despite intensely hot weather and ample host availability, no larvae and no wild flies were discovered for 3 straight weeks. Many people on the project believed that the winter/spring program had succeeded. However, on June 25, Medfly larvae began showing up in apricots in Mountain View, California.

Whether the renewed infestation resulted from the release of unsterilized flies, a failure to detect the presence of additional wild flies, or a combination of both is still in dispute. Within a week, more than 60 new larval finds were identified, concentrated in the Mountain View area. On July 1, 5 days after the first find, Harvey Ford of USDA, Rich Rominger, the Director of the California Department of Food and Agriculture (CDFA), and I appeared before the California Legislature and advised that aerial spraying appeared to be the only option. The spraying would begin on July 13, 1981, if recommended by the Technical Advisory Committee and approved by Governor Brown.

H. Public and Governmental Attitudes

Despite the massive ground treatment and stripping effort in the winter and spring and the overwhelming evidence of new infestation, there was widespread and strenuous objection to aerial spraying. The Technical Advisory Committee meeting on July 7 was attended by approximately 800 people including many local public officials. Nearly all who spoke to the committee testified in opposition to aerial application.

The first witnesses were pregnant mothers and children expressing concerns about the health impacts of aerial spraying. They, and others, all opposed aerial spraying. The Technical Advisory Committee meeting was adjourned at 1630 and reconvened the following morning in Sacramento with Governor Brown. At noon, the Governor announced that he would not order aerial spraying at that time and ordered instead, an even larger ground eradication program.

Instead of 12 Caltrans dump trucks, the Governor ordered more than 200 National Guard trucks into San Jose. He also ordered roadblocks on all major freeways and ordered 300 ground spray rigs into action, instead of the previous 118.

Park rangers participated in notifying the public of eradication steps. The Medfly Project increased from 400 to 4,000 government employees in 48 hours. However, the Medfly infestation grew faster than the efforts on the ground could handle and USDA threatened to quarantine the entire State unless aerial application was ordered. On Friday, July 10, Governor Brown ordered aerial application to begin the following Monday night, July 13, as originally scheduled.

I. Aerial Spraying

Immediately after the Governor's order on Friday, the project printed 40,000 notices of aerial application at the CDFA printing shop in Sacramento and delivered them to Los Gatos during the night. These notices were distributed door to door on Saturday to residents in the first aerial spraying corridor. During the day, a special Medfly Health Advisory Committee assembled and reviewed the notice and recommended that it be changed because the Committee concluded that the notice overemphasized health risks of aerial spraying. At midnight, on Saturday night, project personnel flew the revised notice to Sacramento where 110,000 copies were printed during the night and returned to the Medfly headquarters in San Jose for distribution on Sunday. Over 2 million notices were delivered during the course of the Medfly Project either by hand, door to door, or in some cases, by mail.

In addition, a telephone hotline was set up to answer call-ins from residents about the quarantine, the requirements for renewed stripping, and the aerial spray program. Over a quarter of a million telephone calls poured in during July and August. Radio advertisements were also scheduled to notify residents of the prohibition against moving fruit, the requirement to strip, and on aerial spraying times.

Two press conferences a day were held, one in the morning and one in the afternoon, to further answer the public's questions and to satisfy the media's interest in the status of the project.

Because of the affected urban area and concerns about flight safety, an early decision was made to use helicopters over the heavily populated bay area. However, it was not easy to get the aerial spraying program off the ground. On Sunday, July 12, the U.S. Department of Defense reversed the Base Commander's decision that would have allowed the project to use nearby Moffett Naval Air Station for the aerial application program. The aerial program was then

switched to the next available airport--San Jose Municipal Airport. On Monday morning, the San Jose City Council met in emergency session and cancelled the use of any public airports under their jurisdiction for Medfly spraying. In addition, the county and five cities sued the project in State Court, seeking to halt the spraying. During the day while most project officials were in court, Caltrans and the aerial spraying unit constructed a temporary secret helicopter base in the Los Altos Hills. At 1700, the Superior Court turned down the request to halt the spraying and an appeal to the California Supreme Court for an injunction was denied at 1930. The aerial spray program began a little after midnight July 13, as planned.

Most of the spraying was conducted at night between midnight and 0600 to reduce the number of residents and automobiles exposed to the bait spray. In addition, there was less air traffic at night and cooler, stiller air prevailed for better application. Only one helicopter was used the first night and the thick, sticky corn syrup bait caused its pumps to jam after only six passes. During the first week, the project continued to be plagued by pump problems but, by the second week, corridors were being sprayed on schedule.

To guide the helicopters along a straight flight line, Caltrans crews put engineering markings along various roads so that spotlight crews could move from one mark to the next, setting up a straight line of spotlight beams for the helicopters to guide themselves. Later in the program, electronic guidance equipment was substituted for the spotlight beams.

The ground guidance crews were protected by both law enforcement officers and sand-filled dump trucks. More than a hundred drunk drivers were arrested at roadblocks and there were a number of automobile accidents caused by drunk drivers hitting the rear of both the ground spotlight crew trucks and roadblock obstructions. In addition, there were numerous reports of shots allegedly being fired at the helicopters. Helicopters were struck by gunfire on at least two occasions. There were no accidents during the spray program itself, but in October, one helicopter returning to base after the completion of aerial spraying for that evening, crashed and burned in a residential neighborhood, killing the pilot. There were no serious injuries on the ground.

The helicopters flew at an altitude of 300 feet and 200 feet apart (about 90 and 60 m, respectively). More helicopters

were added to the program as the spray area expanded. At the peak, we were spraying 1,300 square miles (3,400 sq km) a week using two contractors with six helicopters each. A third contractor sprayed with fixed-wing aircraft in the rural areas of Santa Clara, San Benito, and Stanislaus Counties.

In addition to the aerial spraying, roadblocks on all major freeways were maintained from July 8 through October 1. The inspections were conducted around the clock and a total of 5.2 million cars were stopped during the 3-month period. Most of the vehicles stopped were campers and recreational vehicles towing trailers or trucks. More than 100,000 confiscations of host fruit were made and 1,000 citations issued. The roadblocks helped reinforce public awareness of the problem and the prohibition of moving fruit.

Despite the roadblocks and the initiation of aerial spraying on July 14, the Medfly spread during August to the counties of Stanislaus, San Benito, Los Angeles, and Santa Cruz. In addition, areas of Alameda and San Mateo Counties were found infested. A small area of Contra Costa County right on the border of Alameda County was included in the spray zone, although itself not infested.

Fortunately, by that time, reinforcements arrived in the form of a bearded veteran of other insect wars named Dick Jackson. For most of the next 14 months, Dick was the onsite Medfly Project Manager. It is my pleasure to present him to you now.

Dick Jackson
District Director,
Plant Protection
and Quarantine,
Animal and Plant
Health Inspection
Service,
U.S. Department
of Agriculture,
Seattle, WA

As Jerry Scribner mentioned, I will cover the last 14 months of the Medfly Project. My prime topics are the aerial and ground spray project, the expanded detection program, regulatory actions, and lessons learned.

I intend to use slides throughout this presentation in order to cover as much ground as possible while giving you a visual idea of the California Medfly eradication project.

As Jerry indicated, the spray area expanded tremendously in August. Medfly was found again in Los Angeles and the Santa Clara infestation spread to Santa Cruz County, new locations in San Mateo and Alameda Counties, and for the first time, into the agricultural counties of San Benito and Stanislaus.

Medfly is easy to kill with protein bait and a small amount of insecticide. This has been proven time and again in the United States and was the ultimate tool in the recent battle. The formulation consisted of 2.4 ounces malathion (technical grade) and 9.6 ounces Staley's protein bait for a total of 12 ounces per acre.

The strategy called for weekly spray applications for the duration of two Medfly life cycles. If no additional Medfly life forms were found at the completion of the second life cycle, spraying was terminated. High density trapping remained in effect. The quarantine was lifted after the third negative life cycle had elapsed and Medfly declared eradicated. As an extra measure, high density trapping was continued for the fourth life cycle. If this proved negative, trapping was reduced to detection levels.

Thanks to Dr. Dick Tassan, University of California, Berkeley, and Tom Palmer, CDFA, we were able to develop life cycle projections for all treatment areas. Air and soil temperature probes were established at key locations throughout the infested areas and the recordings were fed into the mainframe computer at Berkeley. The resulting feedback allowed us to terminate spraying with confidence after completion of the second negative life cycle.

With the discovery of Medfly in Stanislaus and San Benito Counties, it was clear that a full scale aerial assault was necessary to "get ahead" of the Medfly or face the possibility of living with this pest in California. To do this, we used Federal and State contracting authorities which put us in the air with 19 spray aircraft plus several security and observation aircraft. Spray aircraft consisted of 12 Bell 205 helicopters, 4 DC-4's and 3 PV-2's. The

helicopters worked in the Santa Clara Valley and Los Angeles while the large fixed-wing planes covered Stanislaus and San Benito Counties. Application rates were the same for all aircraft and droplet size of the spray material for all aircraft was surprisingly similar, averaging 200 to 400 microns.

During the early months searchlight guidance was used for helicopter spraying. Later the Loran guidance was used extensively. This greatly improved the swath spacing. The helicopters flew a 200-foot swath at a 300 foot altitude. Their capacity was 250 gallons of spray formulation and the airspeed was about 75 miles per hour (mph).

In the fixed-wing program, only Loran guidance was used. The DC-4's flew an 840-foot swath at a 1,500-foot altitude. Their capacity was about 1,500 gallons and their speed in the neighborhood of 195 mph. The PV-2's flew a 420-foot swath at a 1,500-foot altitude. The PV-2's carried 1,000 gallons of spray formulation and flew about 185 mph.

Spray was shut off for reservoirs, lakes, and sensitive areas such as municipal waterworks. Ground sprayers were used at these locations if host situations warranted.

Applications were made weekly during warm weather. During the winter months, applications were less frequent--usually every 2 weeks.

At the peak, more than 1,350 square miles were treated weekly. A great deal of effort was made to apply the bait during off-hours when fewer people were on the streets and in their backyards. This was not always possible and it kept our 77 telephone operators busy handling complaints, answering questions and, in general, putting up with much abuse.

Opposition to our aerial bait spray was a way of life on the Medfly Project. There is no way to catalog all the complaints, threats, and lawsuits that came our way. The only positive comment that I received during the heat of battle came from a San Jose police officer. This officer allowed that nighttime aerial spray completely solved the "cruising" problem in one application. It seems that the malathion bait was not the best treatment for a freshly polished and waxed "Hot Rod" or "Lowrider."

Scheduling the weekly aerial applications was a nightmare at times. Early morning treatments brought cries of anguish

from the dairy farmer concerned about his cows, spray at 8 a.m. infurated the soccer players and commuters, spray at noon angered the lunch crowd and joggers, spray at 3 p.m. made school officials livid, and on and on.

Ground spraying with diazinon around fly and larval finds was also a prominent eradication activity. Three applications were made at 2-week intervals. This material was used at 5 pounds per acre in 600 gallons of water.

Detection activities during the last 14 months of the project centered on the use of the Jackson trap baited with 2 ml of trimedlure. Fruit collecting and fruit cutting were also accomplished. Trapping was not adequate during the first year of the project. In April of 1981, trap densities were increased to 5 traps per square mile in rural areas. Around infestations, the densities were higher--25 traps per square mile.

In July 1981, a new trapping protocol was developed. This plan called for 50 traps per square mile in core infested areas with trap numbers gradually decreasing to 10 traps per square mile, 4 miles away. In addition, 10 traps per square mile were added to all areas within a 100-mile radius of the Santa Clara Valley. Beyond this perimeter, traps were increased to 5 per square mile in all urban and host areas.

A great deal of effort was expended in trapping quality. Forty additional USDA officers were brought to the project for this quality control effort. At the peak, about 117,000 traps were in use throughout the State. About 35,000 traps were in place in the Santa Clara Valley.

Regulatory activities kept pace with the control and detection. About 200 employees were assigned to this activity during peak operation. During this period, 3,935 square miles were under regulation. Various treatments were available enabling most host material to be moved from the regulated area. In some cases, such as stone fruit, treatments were not available and the risk of spread too great. These crops had to be processed or consumed locally.

As aerial treatment reduced the Medfly populations, USDA quarantine officials allowed regulatory activities to be correlated directly with high quality trapping efforts. In other words, growers and packers were able to move host crops based on negative trapping subsequent to eradication treatments. This was a real boon to the industry and greatly reduced the costs of regulatory requirements.

By the end of June 1982, it was clear that the aerial bait spray and all associated eradication activities had been successful. In fact, using the life cycle data, we were able to drop 400 square miles of treatment area in early October 1981. Another 700 square miles were dropped in November 1981, leaving about 200 square miles for treatment through the winter. The last spray in the Santa Clara County was June 29, 1982, in San Mateo.

On June 25, 1982, a lone male Medfly was found in Stockton, San Joaquin County, California. This triggered aerial spraying on 9.5 square miles for two life cycles. Spraying terminated in August. No further sign of Medfly was found. A single male was also found in Los Angeles. High density trapping failed to reveal additional specimens. No spraying was done.

The 1980-82 California Medfly infestation project officially ended September 21, 1982. Total cost was about $100 million and involved as many as 4,000 employees at one time.

Several lessons stay with me as this episode fades. I trust that we remember these lessons for future programs.

1. A high-quality detection program is critical. Five traps per square mile in high risk areas will detect Medfly early and, therefore, will allow early eradication.

2. The public is an excellent detection resource. Include them in detection programs such as homeowner "call-ins" for larvae or adult Medflies. They add considerably to detection efforts.

3. Develop the use of electronic guidance systems. Initial cost is rather high but the rewards are many--improved swathing, accurate records of sprayed areas, gallons dispensed, time spraying occurred, etc.

4. Standardized statistical forms should be developed and used by all program cooperators assigned to recordkeeping. Ideally, the information should be available by recall from a central computer bank.

5. A large-scale project involving aerial application directly over the roofs of two million inhabitants can be accomplished, with safety and through the

cooperative efforts of many people. This does not imply that the next event will be any easier. On the contrary, I expect it will be equally as difficult.

TECHNICAL ANALYSIS FROM A SUPPORTIVE RESEARCH VIEWPOINT

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In the aftermath of the recent Mediterranean fruit fly, Ceratitis capitata (Wiedemann), (Medfly) crisis, one can readily sense the present-day global network of agriculture interaction. Colleagues from Europe to Australia queried the progress of the battle against this pest. The International Atomic Energy Agency in Vienna, Austria, sent specialists to review progress as it impacted on their supported Medfly programs in other parts of the world. Japan, Mexico, and Central America were vitally concerned both from the standpoint of trade exchange as well as security from introductions to uninfested or Medfly-eradicated areas of these nations. A specific discussion on international impact of the 1980-82 Medfly incident in California is appropriately included as a separate topic on this symposium. The parallel with international concern I wish to make in regard to technical analysis is that we also had a world of resourceful information to draw upon in addition to the accomplishments in researching this pest where it is strongly entrenched in the islands of our 50th State of Hawaii.

The North American continent remains the largest susceptible land mass in the world where Medfly has not become permanently established. Although Medfly has been known to science for more than 100 years, during that time it has spread and been recorded in more than 90 countries. A few examples from earliest records include detection in the Azores in 1829, Spain in 1842, South Africa in 1889, France in 1900, Egypt in 1901, and Hawaii in 1910. Evidence of extending destructiveness is demonstrated in more recent times in northward expansion of Medfly through Central America. Coffee, stone fruits, and citrus in such tropical regions can support explosive populations of this pest and commodity trade offers swiftest movement. Medfly was detected in eastern Guatemala in 1975 and by 1977 had crossed over the western border into Mexico. Bilateral efforts of the United States and Mexico have since contained further spread near the Mexico/Guatemala border. Then, of course, the most recent 1980 incursion into California, which after more than 2 years of monumental human effort has again forestalled spread into U.S. agriculture, reminding us of the constant threat.

Knowledge Base as a Strategy Function

As early as 1918 (Howard 1918),[1] recorded observations and experiments revealed much about the enormous biotic resiliency of the Medfly. In laboratory experiments, mated female flies deprived of fruit in which to deposit eggs or when subjected to cold temperature, began oviposition as actively as younger flies nearly 4 months later when

favorable conditions were restored. Thus the insect has evolved a survival and reproductive system compatible with the seasonality of their host crops. Lengthening of development time in various life stages due to low temperature can result in a 4- or more-month life cycle for an insect that otherwise can regenerate in as few as 19 days in optimal environs. More temperate countries such as Germany and Switzerland above 46° latitude are countries where Medfly is now known to occur. In California, regrettably, the range line must be drawn several hundred miles northward. Even though some self-proclaimed experts still contend that a colder winter would have eliminated the outbreak, it seems far wiser to assume that Medfly could survive wherever its hosts thrive and to develop a plan of action accordingly.

What was available to us in the control tool arsenal? This must be divided into two logistical areas, the first being to curtail spread, and the second to eradicate the contained outbreak. Quarantine and fumigation technology are regulatory measures against spread. Eradication of Medfly in California has negated the enormous expense and effort that would have been necessary to construct fumigation and cold storage facilities. The cost, by State of California computation, would have been an estimated $497 million with $38 million per year in recurrent costs for quarantine compliance (Rowe 1981).[2] Regulating the flow of susceptible host commodities within the infested California counties was, however, an arduous and obviously effective effort.

Validity of the eradication technology employed in eradicating the Medfly from California has a reasonable distribution of supporters and critics. It is relevant to this technical assessment to trace briefly the contribution of scientists in U.S. agriculture. The Medfly was detected in Honolulu, Hawaii, in 1910, having made its way along commercial routes from the Mediterranean via Australia. In 1912, California, the U.S. Congress, and the Territory of Hawaii initiated the Mediterranean Fruit Fly Investigations Laboratory which, through the years, has been located on University of Hawaii land. Other subtropical pests such as the oriental fruit fly and melon fly were transported to the Islands and were investigated as well. Within 4 years following discovery, the Medfly had spread to all the islands of Hawaii. There was an urgency to prevent its ingress into the United States. The early philosophy was not control or eradication of the pest in Hawaii because a good host fruit, guava (Psidium spp.), was so widespread. Rather it was

disinfestation of commodities shipped from the Islands. Quarantine No. 13, enacted soon after the Medfly was found in Hawaii, made it unlawful for a person to ship or carry any fruit from the Hawaiian Islands except ordinary eating bananas, pineapples, taro, and coconuts, and these must bear a Federal certificate of inspection. Research on heat vapor and cold treatments were intensively studied and eventually fumigants such as methyl bromide and ethylene dibromide were developed for Island commodities. Hence, commodity treatment research against Medfly has early origins.

Not until the Medfly invaded Florida in 1929 and lead arsenate insecticide was shown to be effective, did research on eradicative technology using pesticides begin. Hundreds of compounds were screened and tested over the years. It remains fortuitous that Medfly has not developed resistance to one of our safer pesticides, malathion. We continue to watch for this possibility. One considerable advantage of malathion activity on the Medfly is that it quickly affects the Medfly, preventing egg deposition by poisoned females that can occur with some other insecticides. Also, it combines well in formulation with food baits to attract both sexes of the fly to lethal sprays.

In the late 1930's, the attractiveness of proteinaceous, fermenting substances became a focal point of fruit fly investigations. As might be expected, yeast and sugar mixtures attracted these insects. Then, activity among such products as linseed oil and angelica seed oil from the Compositae family were discovered to act as food baits. Curiously, extracts from host fruits did not produce favorable results--an enigma that remains to be explained. Angelica seed oil was very effective in trapping the insect but its volatility produced a lure of short duration and supplies of this compound were also limited. Our chemists undertook the task of analyzing and synthesizing the fractions that elicited response. The simpler, less defined compounds such as proteinaceous baits that attract both sexes remain a component of bait spray formulations. The more complex fractions led toward insect-specific attractants for all three tephritid species in Hawaii. Trimedlure, which contains some four active attractant isomers, is an effective male Medfly lure. For those who would like the chemical name it is tert-Butyl, 4 (or 5)-chloro-2-methycyclohexane-carboxylate. Research is still underway to enhance this compound, to identify the chemical communication between male and female, and to understand response stimuli at the molecular level.

Once again in 1956, a continental invasion by Medfly produced significant scientific advancement through focused support. And again, as with the use of insecticide control, Florida was the proving ground. During a major Medfly outbreak in 1956, it was demonstrated that liquified lures containing fermentatious proteins, when added to insecticide, could be a major contribution in an eradication effort. Bait sprays were born. Also, during and following this outbreak, the need to detect, delimit, and monitor progress led to improved traps and trapping schemes. As a result of continued research, a variety of traps and trapping technology were available in the recent California Medfly crisis. The most efficient and economical was a triangular-shaped paper trap with lure dispensed from a piece of cotton dental roll. Flies were trapped in a tanglefoot-coated insert.

Following the evolution of lures, baits, and insecticides, came an opportunity for research on more target insect specific, environmentally acceptable approaches to Medfly eradication. This involved the sterile insect release technique (SIT). Sterile insects were first used as an eradicative tool in Los Angeles County, California, in 1975-76. Until it was established that resources for sterilized insects could not match the proportionate needs of the 1980-82 Santa Clara County outbreak, it was again a method of choice. So, yet another crisis situation has pointed out the need for more information and accuracy in selecting approved methodology. SIT technology was pressed to the limits of detail needed to be effective. Technology that had served well in smaller campaigns became suspect or unmanageable. Distinguishing released sterile flies from the invading population, assessing the male attractant efficacy under varying climatic conditions, selecting release systems for sterile flies, employing augmentary methods such as fruit picking and ground spraying are but examples of better known and successfully employed measures that seemed lacking in the face of such an explosive situation. Available tools such as day degree population modeling to determine development of the resident population were not applied until well within the program. The level of difficulty in applying certain strategies was geometrically increased in relation to the arithmetic magnitude of the outbreak. We have been dependent on early detection and prompt use of a workable eradication knowledge. That knowledge appeared to be lacking in the recent outbreak, due to the fact that its application was not in synchrony with events as they occurred. The need for a population suppressing aerial spray, for example, could not be successfully argued with the public until the more favored

approach--sterile insect release--proved ineffective for the circumstance. In actual fact, these events should have been performed in reverse order which no doubt could have reduced the need for aerial spraying to a fractional amount.

Technical Viewpoint and Research Challenge

Foremost from the recent experience in California is an increased and growing state of readiness for any future eventuality involving fruit fly threat to this segment of our agro-industry. Science has contributed to State and national plans of action that detail steps necessary to meet such an emergency. These plans must be updated as new discoveries are made and tested to assure that they are applicable in the range of circumstances where our tropical/subtropical agriculture exists.

Several prioritized lists of research needs have emerged which still point to a need to fully understand biological and behavioral characteristics of these tephritid fruit fly pests. The Medfly, like other such pests, is a flying computer. Its sensillae monitor the environment and govern its behavior. We must decipher these mechanisms and use them to develop technology that is least disruptive to the flow of commerce and has least impact on other forms of life.

Safer ways to prevent these insects from invading our continental agriculture system will remain of paramount importance. We need to progress in increasing understanding before possible catastrophe strikes, and not just during such periods of duress.

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My discussion will cover several major facets or activities of the Medfly program and how well they met the objective of eradication of this pest.

Technical Advisory Committee

Early in the course of the program, a Technical Advisory Committee (TAC) was appointed. Membership consisted of Medfly researchers, action program personnel familiar with large-scale program operations against Medfly or other pests, regulatory officials, and representatives of the industry impacted by the pest. The purpose of the Committee was to provide program management with sound biologically-based and operationally-feasible recommendations on technology to be used and the use pattern to achieve eradication. The Committee did not have a managerial function and was strictly advisory in nature.

The need of management for technical assistance was particularly important in the northern California program area. Many entomologists believed Medfly could not survive the winter in the area, based upon bioclimatic chamber data. Previous experiences of Medfly eradication in the United States were in semitropical southern areas where the life cycle was approximately 30 days. In this area of cooler temperatures and with no onsite research on Medfly in the area, we needed some biologically-based method for projection of length of life cycles which was needed for timing of spray applications and to determine when the period of time had elapsed with negative detection to declare eradication.

Accordingly, Ken Hagen, Richard Tassan, and Tom Palmer, using available data, developed a day-degree accumulation model for Medfly development periods. With a network of weather monitoring stations, they used current soil and air temperatures to project length of life cycles. This information was used by program management in making decisions on such actions as treatment intervals, termination of treatments, regulatory actions, and others.

This model served well as a basic guideline for making biologically-revelant decisions in the program. However, we feel it should be refined by further research and similar models should be developed for the other fruit flies which may invade the United States.

I think most persons involved with the Medfly program agree that the TAC served a vitally needed role for program success. The Committee was asked to make recommendations on

just about every facet of the program from need for road blocks, to trap density, to treatment interval and termination. The search for research data upon which to base these recommendations pointed up many areas of needed research. Additional or new research is needed to improve the efficiency of such programs in the future. The Committee, along with program personnel, developed a series of research needs which are being used to set research priorities for the future.

There were some changes in the method of operation of the Committee during the course of the program. During the first year, meetings were open to the public, with the news media and interested individuals in attendance. This resulted in much of the time spent in responding to questions from the floor. It did not allow for the indepth discussion of the issues by the Committee for development of the most viable recommendations for program management.

Beginning in August 1981, the Committee met in closed session for 1 1/2 days and then held an open meeting for 1/2 day to present the recommendations and respond to questions. Later the California Sunshine Law was invoked and the meetings were public again, but questions from the floor were not allowed until after the Committee had considered the issues at hand and developed recommendations. Then 1/2 day was provided for presentation of recommendations and their defense to the public.

It is felt that such a committee is needed for any future program of this sort to insure that the best available technology will be used in an orderly fashion to achieve program objectives and to communicate those recommendations to the public as well as defend them if questions arise.

Sterile Insect Method

During the first year of the program (July 1980 to July 1981), we relied upon sterile Medfly augmented by destruction of host material, ground spraying of host plants, and soil drench with fenthion or diazinon under host plants in the immediate vicinity of the detection site. We had many operational problems with the sterile Medfly method in a program of this magnitude.

The first and foremost problem was obtaining the necessary numbers of quality sterile flies on short notice to cover the infested area with the necessary overflooding ratio. In an attempt to eradicate this infestation with a minimal use of

pesticides, sterile flies were obtained from any location where suitable production facilities existed. At one time during the year, flies were being shipped in from four production facilities including Mexico, Peru, and two laboratories in Hawaii. Because of the delay in startup time (except in Mexico where only limited quantities of sterile flies were available because of their program requirements), adequate numbers of sterile flies were not received until much later than desirable.

Also, onsite quality control showed that current shipping procedures of sterile pupae from production to program site severely reduced adult fly quality and we had great differences in fly quality from some production facilities.

Currently, an effort is being made to resolve the problem of timely availability of sterile flies for use in eradication programs by construction of a standby rearing facility in Hawaii. Funding for the facility has been approved and we are presently planning the building. We expect to utilize the best procedures of the various existing production facilities and put together an efficient semiautomated facility. Plans call for production levels of 10 to 20 million per week in standby status with a capability of increasing to 200 million in 60 days and ultimately reaching a production level of up to 500 million per week.

A great deal of research is underway to work out the feasible automation of several procedures. Also, we have found a great variety in the composition of the larval rearing diet in the different rearing facilities. We are attempting to determine which is the best diet to use in the standby facility. In the area of pupal shipping procedures, we have tests underway on shipments from Hawaii to Guatemala where the flies are used in the Latin American Medfly program. It appears, at present, that the problem is the long periods of time during shipment that flies are held in anoxia to prevent metabolic heat buildup in the shipping containers.

Another major problem encountered involved differentiation of sterile and native flies collected in traps used to evaluate the program. The sterile flies are marked for identification by external contamination with various colored fluorescent dyes. As many as four or more colors were used at various times to identify fly source and to get a reading on quality of flies from different production facilities. The procedure for identification of native flies was to visually screen, under ultraviolet light, all flies caught in the traps to segregate those which were not obviously marked with the

dye. Those not identified as marked were further examined for dye in the ptilinum and dissected to check on irradiation damage to gonads before a fly was classified as native or nonsterile.

As the identification workload grew with increasing numbers of sterile flies being released, there was concern about the effectiveness of the identification system. A test was run in which sterile flies were not marked with dye but with a clipped wing. These were placed in traps without the knowledge of the identifiers and run through the identification procedure and a very low percentage was detected. This breakdown in fly identification occurred just at the time the decision was made to stop using sterile insects and switch to malathion bait spray. All flies caught thereafter were identified by crushing the head capsule to detect the marker dye.

I feel several factors led to this problem of fly identification including: (1) The use of several dyes, especially the green and blue, which in low amounts is hard to distinguish from the naturally-occurring fluoresence of the Medfly. It is likely that the judgment decision of whether or not a fly fluoresces could result in the natural fluoresence causing it to be classified as marked and, therefore, sterile. (2) The Nadel trap was used during this period of the program. This is a dry trap in which the flies could fly around and contact each other before they died. This fly contact could have caused enough contamination of native flies to have them classed as marked sterile flies. (3) During the spring of 1981, 3,000 to 4,000 traps were being run. As the weather warmed and fly activity increased, great numbers of flies were caught (often more than 100,000 per week) which increased the identification workload greatly and likely lowered efficiency.

All persons familiar with this aspect of the program agree that the use of red or orange dye on all sterile flies would have eliminated or greatly reduced this problem. It is estimated that in excess of 90 percent the marked flies can be identified visually if red or orange dye is used. Those flies not screened out could then be checked for dye in the ptilinum and dissected for positive identification. In other words, we still believe we can use the dye marker system for identification in a sterile fly program. However, we would like very much to have a more positive system for identification of sterile flies.

After the problems cited above and the switch over to malathion bait spray in the program, there was considerable discussion as to whether or not the sterile insect technique would ever again be used for eradication of Medfly populations. The TAC made this response to a question posed of the efficacy of the sterile insect method:

"We wish to reaffirm our confidence in the sterile insect concept as a tool in suppression and eradication programs for Medfly when used in the proper context of (a) low wild fly population, (b) high quality sterile flies, (c) properly distributed high overflooding ratios of sterile/wild flies. We do feel the sterile insect method is a viable component of Medfly eradication under the proper conditions and it is included as an option in our contingency plans for future fruit fly problems."

It is felt that we need to improve upon our method of program evaluation during a sterile insect control program. We used dry traps in the California program with the problems cited above. Traps are still our best method for evaluation of such a program but we need a different type trap and a sound basis for using the lowest number of traps possible to still get valid evaluation data. A likely trap for this use is being used by Dr. B. S. Fletcher in Australia, which we plan to test. It is a modified Steiner with a water reservoir which immobilizes the flies and keeps them moist so they can be worked easily in the identification process. We need statistical help for the necessary trap density.

Malathion Bait Spray

This treatment gave phenomenal control as evidenced by the fact that the only Medflies detected in treated areas were following a rain before retreatment was redone, and on the edges of treated areas. However, it is felt some refinement of the bait formulation is desirable. There was considerable variation between batches of bait received in California insofar as viscosity, color, foreign particulate matter, etc. were concerned, which caused problems in getting the proper formulation with malathion for effective application. We do not know what the compound or compounds are in the bait that attracts fruit flies. We hope that the research underway will result in identification of the active components and allow us to specify a more uniform product.

We need more research on treatment intervals to allow full use of the residual action of the malathion bait treatment and thereby use fewer treatments. When the bait spray

treatments began, there was concern about efficacious treatment rates and intervals under California conditions. The application rate (12 fluid ounces of malathion bait in a 1:4 ratio) had been used on a 10-day interval to eradicate Medfly in south Texas. In order to get some data under California conditions, a test was done using sterile flies to evaluate.

Bait spray treatment rates were (1) the standard 12 ounces (1:4 ratio) rate, (2) double the rate to 24 ounces at same 1:4 ratio, and (3) standard malathion rate of 2.4 ounces and double the bait to a 1:8 ratio. These treatments were applied each to a 30-acre block in a walnut grove by helicopter and bioassayed with sterile flies for specified periods of time. Sterile flies were distributed by air every 3 to 4 days over a square mile block containing the test area. Jackson traps which were checked daily, were placed in the treated blocks and in the untreated surrounding area to measure population suppression and the length of residual effectiveness.

Results indicated all treatments reduced populations by 90 to near 100 percent in the 3- to 4-day interval between fly drops during the test. This level of suppression began to decline during the 10- to 14-day period after treatment, indicating a 10-day interval between treatments would give satisfactory control. This type of testing should be done with native populations to determine if bait spray treatments could be extended from 7- to 10-day intervals.

Trapping

The trimedlure baited Jackson trap was used throughout the program for detection and was also used for program evaluation after the changeover from sterile flies to malathion bait spray. This trap worked well and is still considered our best survey and detection device for Medfly.

We had the usual problems associated with such emergency programs where trap data are the basis for major program decisions--how far a trap will attract as a guide to necessary trap density, and how far flies are likely to fly from the site of infestation. Using the available research results and the experience gained in previous programs, the TAC developed the following guidelines:

a. Within the malathion bait spray treatment area during the time treatments are being made--10 traps per square mile.

b. In the treatment area but after treatments have been terminated--50 traps per square mile over a period of at least three Medfly generations.
c. In the regulated area--50 traps per square mile in the first mile beyond the treatment area, 25 per square mile in the second mile, and then 10 per square mile out to a distance of 100 miles from the Medfly infestation.
d. In areas to be trapped not covered by the conditions described above, traps would be used at 5 per square mile in a routine pest detection operation in urban areas and 1 per square mile in agricultural areas.

Good trapping procedures are just as important as trap density for a reliable surveillance program. The following recommendations were made on trapping procedures:

a. Traps are checked (serviced) on a weekly interval. During the cooler months when fly activity is lower, traps may be checked on a 2-week interval.
b. Traps will normally be rebaited on a 3-week interval. However, in hot-dry areas such as the San Joaquin Valley, they must be rebaited on a weekly interval.
c. All trimedlure should be dyed to assist in prevention of trap contamination.
d. Traps should be rotated into preferred fruiting hosts.
e. The host preference list should be revised and the period of year identified when best for trapping.
f. A trapping school should be held at the county level to ensure that all personnel are properly trained.
g. A trapping expert should visit, study, and report on the situation at all sites where flies are detected.

While we will continue to try to improve the traps, our greatest need for research is with the trimedlure formulation. The lure being purchased at present contains eight identifiable fractions, some which are not thought to contribute to attractiveness to Medfly. This lure needs to be cleaned up so that more precise specifications for purchase can be developed. Also, we need to develop a formulation for controlled release similar to the lure strips in use with some other lures to insure a more precise rate of lure in the trap and less chance of trap contamination during servicing.

It is a fact that the lessons learned in the California program have resulted in an increased and redirected research and development effort among research groups. We feel that

the increased emphasis on early detection and the refinement of our control technology will allow us to eradicate any future infestations in a more efficient and timely manner.

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The social and political impact of the Medfly on California political consciousness reminds me a bit of one of those inflatable clowns that are shaped like a bowling pin with sand in the bottom. As a kid you could punch them and they would go all the way over almost to the ground, but then they would right themselves and eventually come back to a kind of true center.

Like the inflatable clown, I think the public has rebounded from total opposition to spraying, to ridiculing those who opposed it, and back again to a more informed and openminded stance.

The Medfly experience is deeply etched in California's recent history and there is no doubt that the public and political leaders have learned some hard lessons from it. However, it is terribly naive and simplistic to assume what has been learned is that massive urban pesticide use will now be welcomed as the treatment of choice for every pest agricultural officials want to eradicate.

What I would like to do now is take you through a series of political cartoons which graphically depict the impact of the Medfly experience on California citizens and elected officals.

First and maybe most importantly, I think the public is far more aware of the tremendous importance of agriculture and its vulnerability to exotic pests introduced from overseas.

The public also understands that pests can be eradicated. I was often asked, "Do you really think you can get every last survivor?" Many people doubted we would ever succeed because they did not believe eradication was an obtainable goal.

Although they support eradication, most people still do not like pesticides, whether they are ground applied as here, or aerially applied by helicopters as seen in the next slide. No matter how one looks at it, aerially spraying <u>anything</u> into peoples' private backyards violates deeply held values. People believe their home is their castle and should be free from Government interference. They also feel their health and what they eat and breathe should be a matter of individual choice, not majority rule or Government edict.

The public understands the importance of early detection and prompt response, probably the two most critical elements of successful eradication programs. Despite a decrease in the overall State budget, the State of California has increased pest response funding by about $10 million. Critical elements

of the State's new pest response program are extensive Statewide trapping and a beefed-up emergency response team. California will be maintaining annually more than 45,000 Medfly traps throughout the State at a density of 5 per square mile in urban areas and 1 per square mile in rural areas. The trapping program also includes traps for other economic pests, such as apple maggot, gypsy moth, Japanese beetle, and other fruit flies.

There is now more awareness of various eradication tools and the risks inherent in sterile insect eradication methods. I personally believe that the sterile male approach holds great promise as an effective and nonintrusive strategy for fighting pests in urban neighborhoods; but it has its drawbacks. It is slower acting, it takes some skill and perseverance to raise millions of sterilized insects, thousands of miles away from the eradication zone, and then ship, rear, and release them properly to achieve eradication. In addition, we found, in our program, some serious problems with sterile insect identification and with assuring irradiation.

The public also understands the importance of pest exclusion programs as the first step in avoiding the need for eradication and in preventing the spread of incipient infestations.

I think both the general public and Government entomologists have begun to take a new look at the fairness of some of our quarantine doctrines. One of the obvious anomalies in our whole quarantine program is that we immediately slap burdensome restrictions on commercial agriculture which is already pretty careful about transporting pests, while allowing free movement of automobile and airline traffic--the major transporters of pests--from one urban neighborhood to another.

Political Impacts

Governor Brown took a terrible beating for his momentary opposition to aerial spraying. In 1980, advocates of mass-pesticide spraying of urban populations to control agricultural pests got the same reception Curtis LeMay got when he recommended "Nuking" North Vietnam, and bombing them back to the stone age. After all, the last time aerial spraying had been used for the Medfly was more than 15 years ago, about the time Rachel Carson was writing "Silent Spring" and several years before the Environmental Protection Agency came into existence. By 1980, public consciousness and support for pesticide use had changed considerably.

In California, our eradication staffs, both at the State and the county agricultural commissioner offices, felt they were leading the country in the use of new and more sophisticated techniques for fighting agricultural pests in urban neighborhoods.

Even in early December 1980 when the Medfly was clearly out of control, there was strong feeling and concern that aerial spraying would set back years of effort in building support in urban areas for eradication programs. It was partly that concern that led the Chairman of the State Assembly's Ag Committee to call all the parties together in Sacramento and force aerial spraying onto the back burner in favor of a ground-based program. Assemblyman John Thurman, backed by the California Farm Bureau Federation, was genuinely concerned that a hastily ordered aerial spray program over one of California's most populous and politically active constituencies, might do more harm to the farmers in the long run than waiting for warmer weather and taking more time to build a consensus that aerial spraying was necessary.

The mobilization of urban residents into stripping programs and the extensive ground spraying during the spring of 1981 provided an opportunity for increased public awareness of the threat the Medfly posed and of the difficulties inherent in a ground program.

The eradication program was featured in the San Jose Mercury News, the major paper, almost every single day from January to June. There were constant articles about: What if aerial spraying has to be ordered and what are the contingency plans? There were lawsuits and a quarantine in March by Texas, and there were threatened quarantines by other southern States.

By June, the public was far more aware than they had been in December that the Medfly was something that could not be tolerated, and that knowledge was undermining their continued emotional, if not intellectual, opposition to aerial spraying as an acceptable strategy.

In July 1981, the pendulum swung the other way. Harvey Ford, Rich Rominger, and I had appeared before the California Legislature on July 1 and indicated that aerial spraying was set for July 13 at midnight, assuming the Governor went along. Aerial spraying was shelved between July 8 at noon and July 10 at 9 a.m., a period of about 41 hours. However, that hiatus in the planning period did not delay the actual implementation time even 5 minutes.

Nevertheless, the Governor was tagged by farm groups already deeply angered by his Farm Labor Board appointments, and they crucified him in the media for weeks and weeks afterward.

Had the elections been held in the summer of 1981, there is no doubt that Medfly would have been a major factor. However, by the time of the primaries in June 1982, the Medfly appeared to be all but eradicated and by the time of the general election, it had been eradicated.

Early in the campaign, Brown's U.S. Senate opponent, Pete Wilson, hoped to make much of it and he referred to it from time to time. But even before the end of the eradication program, the public correctly perceived that the Governor had been trapped in a political no-win situation by the Medfly events.

The public also recognized that farm groups and Republicans were overplaying the issue. President Reagan made no secret of the fact that stopping Jerry Brown was his number one national priority in the United States Senate races.

In California, the Republican Floor Leader of the Assembly in August 1981, went so far as to propose impeaching the Governor over his handling of Medfly. This bit of political grandstanding so alienated rural Democrats that they dropped their criticism of the Governor's handling of the Medfly problem and returned to the fold.

As you know, Brown did lose the Senate race to Wilson, but as this slide illustrates, there were a lot of other factors. In fact, most political analysts feel that his two unsuccessful attempts at the Presidency, his much publicized trip to Africa with Linda Ronstadt, and his Zen lifestyle were the major factors--not Medfly.

In other races in California, opponents of aerial spraying were reelected to office and one particularly strong opponent, Art Torres, former Chairman of the Assembly Health Committee, who during the spraying, held hearings in San Jose on the possible health impacts, moved up to the State Senate. In the meantime, the Governor's leading critic and darling of the agricultural community who proudly wore her "Let Us Spray" button was defeated. Carol Hallett, the Assembly Minority Leader, was rejected by the voters by a decisive margin in favor of a Democrat who has been highly critical of the Department of Food and Agriculture's failure to more

vigorously implement anti-pesticide restrictions and biological control programs. He is now the Lieutenant Governor.

The only Santa Clara politician defeated in his effort to win reelection to the State Senate was, ironically, the one politician who tried to make an issue of whether or not the Medfly Project had been properly run in Santa Clara County.

In sum, I think political leaders will be more inclined to leave unpopular eradication programs up to administrators, so as to avoid falling into the trap that Governor Brown was in. The public, on the other hand, will be much more supportive of quarantines and exclusion programs and more willing to cooperate in pest detection and eradication programs up to, but not including, aerial spraying.

Our experience with the gypsy moth problem in Santa Barbara, California, in January 1981, is instructive. Even as aerial spraying for the Medfly was still going on, the public rejected aerial spraying of carbaryl for gypsy moth in favor of a ground application that was more localized.

I think the public will continue to be wary of widespread pesticide use in their backyards and on their children and pets based on governmental assurances that there will be no significant or long-term health consequences. The public recognizes correctly that, in most instances, we do not have the data to support such assurances. The best that Government can offer is evidence that it has not caused problems before or it has not caused problems in experimental animals. For a public dissatified with the way nuclear radiation hazards have been handled and dissatisfied with the way other public health testing has been handled, these assurances are going to continue to be inadequate.

Finally, I think both the public and their elected leaders will review carefully the proposals of eradication managers and revise those plans just as they did in Santa Barbara in accordance with their own assessment of the relative risks and benefits to the public and to agriculture of the proposed course.

And this is as it should be in a democracy.

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In December 1980, after 6 months of ground control efforts to eradicate the Mediterranean fruit fly (Ceratitis capitata) from California's Santa Clara Valley, the U.S. Department of Agriculture (USDA) and the California Department of Food and Agriculture (CDFA) proposed immediate commencement of 6 to 12 aerial malathion sprayings, encompassing about 500 square miles of the southern San Francisco Bay area, with a population of several hundred thousand people.

This proposal came as a rude shock to most local residents and officials and the medical community who had not been previously informed or consulted about the fruit fly spraying. The spontaneous public outcry against the spraying was vociferous, with public health the primary concern.

In an attempt to address health concerns, the California Department of Health Services, apparently under pressure from the agricultural agencies to make a quick determination,[3] within a week completed an assessment of the health risks from aerial malathion bait spraying.[4]

The Department concluded "...after careful in-depth evaluation that there will be no significant health risks."[5] This summary conclusion may have been reassuring to those who place unquestioning faith in simple answers or in the medical establishment. However, Government assurances that the risks were insignificant could only be considered ludicrous by pregnant women and the parents of small children faced with repeated aerial pesticide spraying against some previously unheard of fruit fly.

Many health experts, including local physicians, Stanford University's entire Department of Pharmacology, and some Department of Health Services staff, expressed concern over, or opposition to, aerial spraying.[6, 7, 8, 9] Local health experts were joined in their concerns by entomologists from Stanford University and the University of California at Berkeley, who stated that little if any control benefit would be achieved by a winter aerial bait spraying. Winter spraying might, in fact, be counterproductive by preventing establishment of an intensified ground program of fruit stripping and soil treatments aimed at controlling Medfly's predominant egg, larval, and pupal winter stages.[10]

In fact, in late November, the agricultural agencies' own Technical Advisory Committee recommended just such an intensified ground effort.[11] While the USDA and the CDFA

were contending in December 1980 that aerial spraying needed to commence immediately and posed no risks, the agencies' own entomologists stated that it would be of little benefit.

Many people interpreted the agricultural agencies' winter spray proposals as pure politics. The agencies were attempting to cover their political backsides by responding to agricultural interests which had by that time become highly critical of the eradication effort.

Not only did the political nature of the spray proposal, which was contrary to entomological recommendations, become quickly apparent to the public, the agencies had committed tactical errors by proposing to spray without first conducting a formal health-risk assessment, consulting local officials, and diligently exhausting alternatives.

In response to these concerns and opposition to aerial spraying, a well-coordinated and adequately funded ground control program was implemented against Medfly in northern California for the first time in January 1981. This program consisted of removal of fruit potentially infested with eggs and larvae, release of sterile flies to disrupt Medfly breeding, application of insecticides to the soil to kill pupae, ground bait sprays to attract and kill adult flies, and a quarantine prohibiting movement of potentially infested fruit. The ground program appeared successful and Medfly victory celebrations were being planned when larvae were again found in late June of 1981.

The appearance of these new larvae probably resulted from an unknown combination of factors. A dye color used on some of the released steriles was difficult to distinguish from wild flies. Inadequate detection the previous year had failed to define the scope of the infestation, so the ground control efforts were too localized. A batch of supposedly sterile but actually fertile Medflies from Peru apparently was released. Not enough is known about the Medfly's life cycle in cooler northern climates.

The new larvae appeared at the height of Medfly's summer reproductive capacity, when tons of ripe fruit were on backyard trees. This prompted Medfly technical experts to first recommend aerial spraying in early July of 1981.[12] Governor Brown delayed authorization of spraying for several days, instead ordering an intensive ground program which some experts believed could again be successful. However, the Federal Government threatened a Statewide quarantine that

would have necessitated extensive use of ethylene dibromide, probably the most toxic and hazardous pesticide in use.

It was also questionable whether public and worker health would have benefited by an extensive and hastily organized summer ground spraying program which the agencies would have employed as an alternative to aerial spraying. Because of the adverse pesticide-use impacts of living with the Medfly (primarily by increased agricultural pesticide use resulting in increased worker and environmental contamination and more residues on foods), most environmentalists dropped their opposition to aerial spraying. Aerial spraying commenced on July 14, 1981, and continued through the summer of 1982.

The impacts of Medfly eradication are many and varied. Approximately $100 million was expended, making California's Medfly eradication possibly the single most expensive urban pest management project on record. California presently faces a record State budget deficit, and Medfly eradication diverted the State's limited funds from other needed projects.

Several million pounds of malathion, diazinon, fenthion, methyl bromide, and ethylene dibromide have been employed in the project. Large quantities of these pesticides were applied without any benefit. For example, half a million gallons of soil drench containing the organophosphate fenthion were applied before it was discovered to be largely ineffective in the bay area soils where it was being used. Ground and aerial spraying were conducted in "preventive" spray areas where no Medflies were ever found[13] and in areas where many experts are certain that the flies were planted in traps.[14] Most, if not all, of the fumigant-treated produce contained absolutely no Medflies.

Some of these pesticides apparently killed beneficial organisms, such as the imported ice plant scale parasite,[15] and led to secondary whitefly and aphid outbreaks.[16, 17] Several fish kills, including thousands of Gambusia (mosquito fish), have been confirmed.[18] Thousands of auto finishes were spray damaged, resulting in about $16 million in claims against the State.[19] Some allergic health reactions occurred, and certain residents have attributed a host of their ills to the spraying[20, 21, 22] and submitted health claims in excess of $1 billion.[23]

Medfly is widely perceived as visible evidence that integrated pest management programs or sterile insect release techniques cannot work against this insect. This

is certain to have negative impacts on future control programs against Medfly and other pests, as pesticide advocates rally around the battle cry "Remember the Medfly!" This was illustrated in 1981, when Medflies were found in Florida, where it has frequently appeared in the past, and again in Los Angeles. Both of these finds and the 1982 find in Stockton, California, were smaller than the 1975 Los Angeles infestation which was eradicated by using sterile insect release. But aerial bait sprays were employed in each of these cases, although a more recent Medfly find in Los Angeles was not treated and no subsequent Medflies were detected there.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is now up for Congressional reauthorization, and Medfly has been used as an example of "...the need to weaken overly restrictive pesticide regulations." Actually, no regulations prevented Medfly spraying. However, Medfly rhetoric is assisting industry's efforts to prevent public access to health and environmental data on pesticides and to dismantle States' rights to regulate pesticides more stringently than President Reagan's Environmental Protection Agency.

California's Governor Brown, partly because of the false perception that he delayed aerial spraying long after experts recommended it, became the scapegoat for deficiencies in eradication efforts. His recent loss in the California Senate race has been partly attributed to this perception. This may discourage other politicians and scientists from taking a strong stand against inappropriate pesticide use when the political stakes are high.

There are some positive aspects to the eradication program besides the successful eradication of the Medfly. It provided the political impetus for appropriation of funds to build a permanent, high-volume sterile Medfly rearing facility in Hawaii. It has also prompted the allocation of funds to establish a birth defects registry in the Santa Clara Valley, which will provide answers to future questions on whether a particular chemical exposure or lifestyle presents hazards to the unborn. I also hope that it has ingrained in agency decisionmakers the need to consult with and involve the public and local decisionmakers in planning and implementing projects that affect their communities--though I am not confident that it has.

It is unfortunate that urban communities are often looked upon and treated by the agricultural agencies primarily as

antagonists, rather than as a potential resource. For example, the Medfly Project at one time employed almost a hundred people who collected and incubated nearly 100,000 fruit samples which were observed for Medfly emergence. Despite this effort, the majority of Medfly larval finds were made by homeowners, and reported even though they knew this would precipitate pesticide spraying in their neighborhoods. Many thousands of residents participated in the winter fruit stripping programs, removing their long-nurtured backyard produce, which might harbor Medfly eggs and larvae. In Palo Alto, for instance, 500 volunteers turned out one afternoon and in 2 hours distributed to each of the city's 15,000 residences fruit disposal bags and return postcards for homeowner use in requesting fruit stripping assistance. The Medfly Project estimated that volunteer fruit stripping programs removed an average of 85 percent of backyard fruit over a many square-mile area.[24]

The substantial involvement of local citizens in Medfly eradication efforts is not an isolated instance of citizen participation in urban programs designed to control pests of communitywide impact. Urban communities have significant resources which can be devoted to pest management if residents are involved in the decisionmaking and implementation of projects which they deem to be in their best interest.

This availability of community resources is one point on which I would like to elaborate, because it presents a promising alternative to expensive high-technology pest management projects which have typically been imposed upon communities. For example, California has a native shade tree defoliator known as the oak moth (Phryganidia california). Oak trees and oak moths have probably coexisted in California for centuries. As with the gypsy moth throughout much of its native European and Asian habitats, oak moth populations are normally held at innocuous levels through the control exerted by natural enemies, food availability, and harsh weather. California oak moth populations peak every 3 to 7 years, during which time the caterpillar stage may temporarily defoliate the leaves of entire trees. The large number of moths and larvae and the temporary defoliation of some trees are annoying to many people. The plant stress induced by temporary defoliation may hasten the death of some poorly maintained or diseased trees. However, healthy oaks are killed rarely, if ever, and can tolerate several seasons of repeated leaf loss. The oak moth is primarily an aesthetic annoyance to urbanites. Much of the controversy centers not on the insect, but on the decision whether or not to spray toxic chemicals.

The city of Sausalito (population 7,000) in Marin County in northern California is one community which has attempted to resolve the conflict between those who prefer to spray pesticides and residents who are more concerned about the adverse impacts of toxic sprays on their health and environment. The Sausalito City Council, at the urging of Citizens for a Better Environment and local residents, has addressed these concerns through formation of the Sausalito Pest Management Committee, which has implemented a citizen oak moth education, monitoring, and control program. Residents were informed about oak tree maintenance, oak moth biology and control, and the interactions among people, the insect, and the environment. Workshops were held featuring experts from the John Muir Institute, who also provided residents with a step-by-step procedure for monitoring trees for the presence of oak worms. (Monitoring is required in order to determine if enough young larvae are present to present a problem if no control action is taken.) Volunteers took responsibility for monitoring a few favored oaks in their neighborhoods. Residents then provided this data to the Sausalito Public Works Department.

The Sausalito Public Works Department combines the citizen oak worm monitoring information with data gathered from their own monitoring of selected oak trees. If large numbers of small oak caterpillars are found in some neighborhoods, Public Works sprays those trees with Bacillus thuringiensis (Bt). Monitoring of Sausalito's street trees during the spring and summer of 1982 revealed that the oak worm population had declined naturally to below pestiferous levels. The Public Works Department decided, based on the larval monitoring, that only a dozen trees needed Bt applications. The appropriateness of this decision to limit spraying was later borne out by the lack of noticeable defoliation or citizen complaints. The program also reduced demands on city staff and equipment and saved money.[25]

Citizen education, monitoring, and control programs like Sausalito's have also been effective against the gypsy moth (Lymantria dispar). In 1978, eight gypsy moths were trapped in McHenry, Illinois, a small town about 50 miles northwest of Chicago. One hundred sixty-five moths were trapped in 1979, and the United States and Illinois Departments of Agriculture proposed aerial application of carbaryl. Residents and local officials were concerned about the potential adverse effects of exposure to carbaryl, but the agricultural agencies persisted with their spray plans. However, with the assistance of Citizens for a Better Environment's Chicago office, McHenry residents were able to

obtain an injunction against the spraying of carbaryl. McHenry residents forced the State and Federal governments to implement an alternative gypsy moth eradication program relying upon use of traps to capture adult moths, tree banding to capture and monitor the presence of crawling larvae, and use of the bacterial insecticide Bt. Residents maintained their own traps and banded several hundred trees in the center of McHenry's gypsy moth population and applied Bt from the ground. Two aerial applications of Bt were made by the State and Federal governments in the spring of in 1981. In the summer of 1981, no moths were captured in McHenry for the first time in 3 years, and no egg masses have been found.[26, 27]

While there are many obvious differences between Medfly and the gypsy moth, the parallels are quite striking. As with the Medfly, the policy of gypsy moth eradication is institutionalized in California's State and county pest regulatory programs. While this policy may be appropriate for an exotic agricultural pest like the Medfly, there are serious questions about the appropriateness of the gypsy moth eradication policy upon which California has embarked. Gypsy moth eradication efforts in the Eastern United States have failed completely, and California's so-called eradication efforts probably must be looked upon as a holding action designed to delay gypsy moth's establishment and postpone the accompanying nuisance, loss of some trees, and increased pesticide use.

At least seven urban gypsy moth eradication projects are planned in California this spring. Several of these communities were extensively sprayed last year for Medfly, and this spring, the CDFA would like to treat them with aerial applications of carbaryl. Given gypsy moth's spread into the Midwest and its high rate of introduction into California, the public will seriously question the wisdom of California's short-term gypsy moth eradication expenditures of millions of dollars when these funds might better be spent on developing and refining long-term solutions to live with this and other urban pests, such as the community-based programs I have described.

Putting aside these questions and assuming that California has appropriately embarked upon an eradication strategy, it is instructional to evaluate how much the CDFA has learned from the Medfly experience.

The technical problems which plagued Medfly eradication efforts have apparently been resolved in the gypsy moth

control program. The State is peppered with thousands of traps, some of which are maintained in areas where no gypsy moths are expected to be found. Border exclusion programs to reduce gypsy moth introductions are being beefed up. A rather clear hierarchical decisionmaking process has been established within the agency, spray materials have been tested under California conditions, and the Legislature and the Attorney General are paving the way for steamrolling over the anticipated spray objections of local communities.

However, more interesting than these technical questions posed by gypsy moth eradication are the sociopolitical parallels to Medfly, which the agricultural agency appears to have missed. As with Medfly decisionmaking, local communities are not being consulted in the decisionmaking and policy-formulation stages. According to the Department of Food and Agriculture, specific plans for each county where gypsy moth eradication is planned are being prepared by considering the comments of staff, agricultural commissioners, and the Gypsy Moth Science Advisory Panel, which was selected by the Department.[28] No environmental impact report is being prepared, no formal health assessment of the proposed chemicals is being conducted, and there are no plans to involve local residents in decisionmaking or project implementation.

These deficiencies are all the more striking in gypsy moth planning, because unlike the Medfly, gypsy moth is primarily an urban pest and the desires of informed urban dwellers should play a critical role in California's gypsy moth decisionmaking.

The importance of appropriate decisions and decisionmaking processes for Medfly and gypsy moth go far beyond their implications for these particular programs. Because of their high visibility and widespread impacts on thousands or even hundreds of thousands of people, these regionwide projects significantly influence the public's perception of appropriate pest management.

Urban dwellers face a wide variety of pest management problems. Rats, mice, fleas, cockroaches, ants, termites, weeds, and plant diseases are just a few of the many organisms which, for reasons of aesthetics or public health, may be undesirable and are, therefore, considered to be pests. However, in the absence of areawide spray programs against pests such as the Medfly, gypsy moth, or Dutch elm disease, most urbanites tend to think of pests and pesticides as primarily rural or agricultural problems.

Many professionals believe that urban pest problems have increased dramatically in recent decades. This increase coincides with a shift away from traditional control techniques such as pest-resistant building construction, sanitation, and trapping. It also parallels a growing ignorance among urbanites of the basic biology and beneficial role of many of the organisms, particularly insects, that surround us. Pesticide use has also increased dramatically; the CDFA estimates that 100 million pounds of active ingredients of pesticides are used in urban area of California each year.[29] The Department further estimates that 14,000 Californians each year seek medical assistance due to pesticide exposure, primarily due to home and garden use and abuse situations.[30] Based on a nationwide survey, the U.S. Environmental Protection Agency concluded that consumers suffer more than $100 million a year in non-health-related losses due to home pesticide use.[31]

The potential to reduce these problems through examples set by high-visibility, communitywide projects makes appropriate decisionmaking and implementation of publicly administered pest control programs vital. Citizen involvement is not merely a legal prerequisite or an expectation in our democratic society. The very success of many urban pest management programs, particularly the fulfillment of the long-range goals towards which a specific project is aimed, hinges upon the active and informed participation of local citizens.

MEDFLY'S EFFECT ON INDUSTRY

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Introduction

A. Scope--The impact of regulatory actions on the agricultural industry resulting from the Mediterranean fruit fly (Medfly) infestation.

B. Some of the statutes and laws involved at various times in the Medfly problem:

Federal Plant Quarantine Act
Federal Plant Pest Act
Federal Insecticide, Fungicide, and Rodenticide Act
Federal Food, Drug, and Cosmetic Act
National Environmental Policy Act
Occupational Safety and Health Act
California Carcinogen Control Act
California Government Code
California Labor Code
Federal Tort Claim Act
California Tort Claim Act
The Constitution of the United States
The International Plant Protection Convention

C. Government agencies involved: At various times the problems related to the Medfly touched 13 agencies, the White House, the Governors' offices of California, Florida, and Texas, and the Governments of Japan, Korea, Taiwan, and Mexico.

Impacts

In discussing impacts, I have separated these into two categories, initial impacts and major impacts. The initial impacts center around the quarantine action taken in response to the Medfly.

A. Quarantines

1. When the Medfly problem became known, the response of the U.S. Department of Agriculture (USDA) and the California Department of Food and Agriculture (CDFA) was to prevent its spread and to eradicate the pest. Preventing its spread involved controlling interstate and intrastate commerce through quarantine action.

2. What a quarantine means:

   a. It is not the blanket cessation of commerce.
   b. It usually involves regulating a limited area and only specified commodities, with provisions made for treatment of most commodities in order for them to be moved in commerce.

3. The effect of the USDA and CDFA quarantines on industry: Minimal

   a. Some increase control cost (example: "preventative spraying by producers").
   b. Some negative publicity with consumers arising out of the treatment of crops. Sales were not significantly affected.
   c. Because of the limited size of the area quarantined, there was little direct effect on industry. It must be remembered that the quarantines were not in the major-growing areas of California. The quarantines were basically urban quarantines. While this gave rise to problems in terms of eradicating the pest, it had very little direct effect on the ability of the agricultural industry to function.

B. Other State Quarantines:

1. A number of States, primarily Texas and Florida, implemented quarantines in reaction to the Medfly situation in California. This was based upon:

   a. Fear of spread of the pest to their State.
   b. An attempt to force stronger measures on California to eradicate the pest.
   c. Politics and trade jealousies.

2. The requirements established by the State quarantines were in addition to, and at times in conflict with, the interstate quarantine requirements established by the USDA. For example, the Texas and Florida quarantines required treatment of commodities originating from all parts of California shipped into those States. The USDA quarantine only required treatment of specified commodities originating from a limited part of California.

3. The State quarantines were an attempt to address a biological problem on a political basis.

4. The effect on California agriculture:

   a. Disruption of interstate commerce for several weeks.
   b. Industry initiated litigation both in the Federal District Courts and the U.S. Supreme Court to have the State quarantines set aside. The USDA ultimately was permitted by the Justice Department to intervene and support industry's suit against those States. Ultimately, industry and the USDA prevailed and the conflicting State quarantines were struck down.

C. Foreign Quarantines

In addition to domestic quarantines, industry had to contend with a number of quarantines established by foreign governments, including in particular Japan, Korea, and Taiwan.

1. Foreign quarantines had substantial impacts on industry, particularly the California citrus industry.

2. The foreign quarantines generally were of the entire State and required treatment of commodities shipped from California to those countries.

3. In some instances, no Medfly treatment existed for the particular commodity. Therefore, no shipment was permitted, (example: Strawberries intended for shipment to Japan).

4. Where domestic California agriculture had not been significantly affected by the Medfly, it was affected because of these international pressures.

Major Impacts

The most significant effect on industry grew out of problems associated with the treatment of commodities as required by domestic and foreign quarantines. There are a number of ways to treat commodities for quarantine purposes: Heat, cold, irradiation, and fumigation. For the Medfly, the most widespread and most effective treatment without injuring the commodity is treatment with ethylene dibromide (EDB). The need to use EDB resulted in domestic and international problems for the agricultural industry, including California, Texas, Florida, and Hawaii.

A. California Occupational Safety and Health Administration (Cal/OSHA)

1. With the realization of the need to fumigate some commodities with EDB in California and with the "sudden" realization that EDB-treated commodities were entering and had been entering California from other States as a result of other plant pest problems since 1972, the Governor of California and Cal/OSHA staff decided that California workers handling EDB-fumigated commodities were facing an imminent health hazard. This hazard was a result of the phenomenon of "off gassing" which occurs after treatment with EDB. When EDB is applied to a commodity, a certain amount is absorbed by the commodity and the container in which it is packed. The EDB then is released from the commodity and/or container over a period of time. Consequently, as workers are handling EDB-treated commodities, they are exposed to various levels of EDB through this "off gassing" process.

2. There is an existing Federal worker occupational exposure standard to EDB which was set by the Federal OSHA in the 1970's. This is a level of 20 parts per million (ppm). This means that over an 8-hour day, the time weighted average (TWA) of a worker exposed to EDB cannot exceed 20 ppm. A short term ceiling level of 50 ppm also exists.

3. Cal/OSHA, on an emergency basis, dropped the occupational exposure standard from 20 ppm to 0.130 ppm or, expressed in other terms, from 20,000 parts per billion (ppb) to 130 ppb. Further, the ceiling was dropped from 50 ppm to 130 ppb.

4. Cal/OSHA also declared EDB to be a carcinogen and imposed certain work practice requirements on employers whose employees handled EDB-treated commodities. For example, it required the posting of signs in the workplace where EDB-treated commodities were being handled. The signs stated, essentially: WARNING EDB-CANCER HAZARD-MAY CAUSE STERILITY. Cal/OSHA required employers to have respirators and self-contained breathing apparatus (SCBA) available and used by employees when the levels of EDB were at above 130 ppb. These respirators affectionately became known in the industry as "Moon suits."

5. Result of Cal/OSHA action:

   a. A number of California employees refused to handle treated commodities.

   b. Most California retailers refused to handle EDB-fumigated fruit. They were particularly concerned with the respirator and the posting requirements, and the potential liability that might result from handling such fruit.

   c. Citations were issued to handlers who tried to handle EDB-treated commodities and could not meet the standards issued by Cal/OSHA.

   d. There was a disruption of commerce between Texas, Florida, and Hawaii with California. The losses by disruption for less than a year were conservatively estimated at $10 to $50 million.

   e. There was a disruption of foreign trade, particularly with Japan. That country adopted the Cal/OSHA standard almost immediately after it was promulgated by Cal/OSHA. Interestingly, Japan considered applying the 130 ppb worker exposure standard as a food residue tolerance as well. It should be noted also that Japan continued to not apply the standard to its domestic fruit treated with EDB.

6. Industry reaction:

   a. Litigation was instituted in Federal and State Courts, principally by the Florida citrus industry, in an attempt to set aside a State standard on procedural grounds. That litigation was unsuccessful.

   b. A number of companies initiated projects with USDA and CDFA to develop treatment techniques to minimize worker exposure.

   c. A number of members of the industry sought help at the Federal level to have a national policy on EDB issued, thereby, preempting the California standard. EDB had been used for a number of years in many States, particularly Florida and Texas, without any evidence of adverse affects. It was felt that since the chemical was used

throughout the United States, a national policy on EDB should be issued. The White House became involved and established an EDB Interagency Task Force. This task force consisted of representatives from USDA, EPA, OSHA, FDA and NIOSH. While there was an initial success in establishing the task force, it soon disintegrated. Each agency seemed intent on handling the problem on its own. Consequently, currently, the OSHA is working on a revised worker exposure standard which is expected to be published as a proposal sometime in 1983. The EPA is working on revising the registration requirements for EDB and establishing a food tolerance for EDB. It is expected that EPA will publish a regulatory decision related to EDB within the next several months. The USDA continues to work with industry to develop treatment techniques to reduce worker exposure to EDB.

d. A number of members of industry sought the help of the USDA and State Department to convince the Japanese and other foreign countries of the need to redraw their quarantines to coincide with the USDA quarantine zones, that the USDA had the situation in hand, and to help calm any concerns those countries might have regarding handling EDB-treated commodities.

Medfly Aftermath-Net Impacts

A. Disruption of domestic and foreign markets. Time is going to be needed to restore some of these markets. Further, there was some displacement of U.S. commodities which had a negative effect on the U.S. balance of payments. However, generally it appears that the U.S. agricultural industry has rebounded well in these foreign markets.

B. Some companies, including citrus packinghouses, went out of business. This resulted in the loss of jobs. This is not to say the Medfly situation was the sole cause for the demise of these companies. However, it can be said that the problems arising out of the Medfly problem contributed significantly to their demise.

C. Jurisdictional problems over the regulation of pesticides, including basic questions regarding how to regulate pesticides and their use, became more apparent. The need

for more organized and coherent regulation in the pesticide field became painfully obvious.

D. Anxiety was created in some workers' minds regarding the state of their health, particularly with respect to their ability to have children, from having handled a carton of fumigated fruit.

E. Monetary claims were filed against Federal and State governments for damages arising out of the Medfly situation.

F. New commodity treatment techniques were developed. These techniques helped reduce worker exposure to pesticides.

G. A better Medfly surveillance system was developed. This should minimize the likelihood of another major outbreak of the pest in California.

H. Better relations were established with a number of foreign countries regarding the handling of plant quarantine matters. This should help facilitate international trade in agricultural commodities.

I. A better understanding was developed by the public of the potential impacts of plant pests on agriculture and the need to address plant pest problems quickly and effectively.

FOREIGN IMPACTS OF CALIFORNIA MEDFLY INFESTATION

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When Mediterranean fruit fly (Medfly) was detected in California on June 5, 1980, the U.S. Department of Agriculture (USDA) notified foreign countries of the pest's occurrence in the United States. As a signator to the International Plant Protection Convention, the Department is also obligated to notify the Food and Agriculture Organization of the United Nations (FAO), Rome. Further, past experience in the 1974-75 oriental fruit fly and the 1975-76 Medfly infestations in California indicated that regulatory actions, by foreign market countries, were less stringent when they were kept informed. Lack of information and/or inaccurate information generates suspicion and regulations with adverse effects on domestic exports.

In spite of the open communication established, eight foreign countries did ultimately establish regulations more stringent than USDA. They ranged from complete embargo to establishing much larger regulated areas than the Department's and/or requiring additional treatments. The countries involved were Japan, Republic of China, South Korea, Trinidad and Tobago, Dominican Republic, Ecuador, Barbados, and Fiji.

Their positions were as follows:

Japan

Japan continued to permit the importation of fresh fruits produced in California when treated according to schedules mutually agreed upon by Japan and the United States. Excluded from this arrangement were fruits normally prohibited entry into Japan under provisions of the Japanese Plant Protection Law and those produced within any area regulated for the Medfly. Acceptable treatments included ethylene dibromide, methyl bromide, and cold storage depending upon class of fruit involved. Intransit cold treatment in refrigerated holds or containers was accepted by the Japan Ministry of Agriculture, Forestry, and Fisheries.

Republic of China (Taiwan)

Apple, pear, grape, and citrus fruits produced in California were permitted entry into the Republic of China when originating from areas regulated for the Medfly and subjected to cold storage or combination cold storage and ethylene dibromide fumigation. All other fruits and vegetables

produced in the State of California were enterable into the Republic of China subject to restrictions in effect prior to the Medfly problem.

South Korea

All fresh fruits that were previously enterable into South Korea from California were subjected to an approved Medfly treatment schedule.

Trinidad and Tobago

Certain Medfly host fruits were prohibited entry into Trinidad and Tobago when originating in the State of California.

Dominican Republic

Host fruits and vegetables originating in any area of California regulated for Medfly were subjected to an approved treatment schedule. Regardless of State of origin, all fresh fruits and vegetables must have been transported in refrigerated containers maintained at a temperature range between 32^{o} to 36^{o} F.

Ecuador

Ecuador placed a prohibition on fresh fruits and vegetables originating in the State of California.

Barbados

Barbados placed an embargo on the importation of all fruits and vegetables originating in the State of California.

Fiji

Host fruits (except citrus) originating in any area of California regulated for Medfly must have been subjected to continuous cold storage at a temperature range between 32^{o} to 34^{o} F. for a period of 16 days prior to export. Products produced in an area regulated for Medfly were also permitted to be cold treated while in transit to Fiji. Citrus fruits exported to Fiji from any State of the United States must be subjected to two ethylene dibromide fumigations prior to release to the importer. If the required fumigations are not performed prior to export, the fruit will be fumigated on

arrival. The double fumigation is considered necessary by Fiji to devitalize scale insects frequently intercepted on citrus fruits.

Market losses suffered by the industry because of foreign regulatory action appeared to be directly related to market size. Losses of limited markets can usually be compensated for by new markets the industry develops.

This may still cause severe losses to some individual producers as in the case of a producer of high quality strawberries, who was able to easily find outlets for his berries, but with a loss of about 45 percent in profit.

Large markets such as the Japanese lemon market produced a much more severe impact to the industry. Direct market losses were probably at the level of $20 million. The industry could not find any available market to absorb the approximate 40 percent additional commodity load. Therefore, prices were depressed and frozen concentrates were put up in quantities, which backed up into the 1982 market.

Impacts to oranges and grapefruits were considerably less because much of the crop had already been marketed before foreign regulation and restricted importation. Those same restrictions were relaxed somewhat before the next crop was harvested.

Other parts of the industry also suffered substantial losses in proportion to their gross dollar value. Those included honeydew melons at $1 million, grapes $2 million, strawberries $2.5 million, and avocados $5 million.

The industry has stated that substantial losses were accrued in other areas directly related to the Medfly infestation but, unfortunately, there is no hard information available. Commodities diverted enroute, transhipped, and segregated required that new markets be found--all contributing to a chaotic situation. Fortunately, the dislocation of the enroute commodities was for a fairly short time and was pretty well sorted out by the end of a 6-week period.

Total losses attributed to foreign market restrictions have been quoted as ranging from $40 to $73 million. Regardless of which figure is selected, it is apparent that losses were much less than the California marketing service projected on a worst case basis (all Medfly host commodities prohibited from foreign markets) of $539 million.

Nevertheless, it should be emphasized that $40 to $73 million is a sobering figure when that level of loss occurred with essentially no significant amount of production area actually infested.

Other States were also affected, but to a lesser degree and, in some cases, the impact was positive. Texas was able to capture, at least temporarily, some of the citrus market California lost. Conversely, Texas had to deal with more stringent foreign requirements and increased inspection by OSHA, CAL/OSHA and EPA. In fact, for a period of approximately 4 months, the normal 180 to 200 carloads a week dropped to about two-thirds.

Even the curtailed shipments proved to be a mixed blessing because new approaches were developed such as the use of bait sprays and sterile flies as a basis of certification for movement. Additionally, special studies were initiated which could be invaluable in the future.

Florida was not adversely impacted by the California Medfly program, with some exceptions early on. The effect was mostly in disruption of shipping. It was necessary for Florida shippers to redirect enroute commodities and react to short-term changes in marketing.

Associated effects have been considered by various segments of the industry and governmental agencies but we do not know of any attempt to qualify losses. Included within this category are losses by workers in packing and related establishments' loss of revenue by shipping and trucking firms, and brokers, etc.

If the United States had chosen to live with Medfly, the eventual losses to foreign markets would probably have been catastrophic.

Foreign governments faced with internal grower pressure and regulating with a philosophy of almost a zero risk basis will not accept Medfly host commodities from U.S. regulated areas even when treatments and other safeguards are applied.

Therefore, it is almost certain that if the United States were to become infested across the pests' entire potential ecological zone, all Medfly export host commodities would be embargoed by at least the eight countries, with restrictions greater than the United States. In addition, it is believed

that at least four more countries would take similar action. Those would be Mexico, Peru, Chile, and Peoples Republic of China.

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